

**In the Title**

***Kindly replace the Title with the following:***

**DESCRIPTION**

LAMINATED FILM[[S]] AND METHOD FOR PRODUCING [[THE ]]SAME

### **In the Specification**

***On page 1, kindly replace the first two paragraphs with the following:***

#### **Related Applications**

This is a §371 of International Application No. PCT/JP2003/016702, with an international filing date of December 25, 2003 (WO 2004/060656 A1, published July 22, 2004), which is based on Japanese Patent Application No. 2003-000220, filed January 6, 2003, and 2003-148825, filed May 27, 2003.

#### **Technical Field**

~~The present invention~~This disclosure relates to laminated films. ~~The present invention,~~ particularly ~~relates to~~ laminated films useful for various industrial applications such as circuit substrates, magnetic recording media, process sheets, release liners, plate-making materials, optical display materials, molding materials, building materials, and electrically insulating materials.

#### **Background-Art**

Films are used for various applications, in massive demand, such as agricultural materials, packaging materials, building material, and industrial materials including magnetic recording media, circuit materials, plate making/printing materials, process/release materials, printing materials, molding materials, and electrically insulating materials.

***Kindly replace the paragraph spanning pages 1 and 2 with the following:***

In recent years, demands for flexible printed circuits (FPCs) have increased as electronic devices such as mobile phones have increased in performance. Since such devices have been reduced in size and weight, the FPCs have been reduced in thickness. Therefore, copper-clad polyimide films for the FPCs and copper layers included in such films have been also reduced in

thickness. This leads to a reduction in film stiffness, resulting in difficulty in processing the films during the manufacture of the FPCs. ~~In order to~~To readily handle the films during processing, the following technique is used: slightly adhesive supporting films that can be peeled off or removed after processing are attached to the polyimide films such that the resulting polyimide films have increased stiffness. Examples of such supporting films include polyester films. A method for manufacturing an FPC using such a technique includes a step of hot-pressing a copper-clad polyimide film having a supporting film attached thereto, a step of curing the polyimide film, and/or a step of mounting IC chips on the polyimide film. Since a polyester film has a thermal expansion coefficient greater than that of the copper-clad polyimide film and is therefore inferior in thermal dimensional stability as compared to the polyimide film, the following problem occurs during steps of manufacturing the FPC: the polyimide film is warped or reduced in flatness due to the thermal distortion of the polyester film.

***Please replace the paragraph spanning pages 2 and 3 with the following:***

In electrical or electronic component applications, polyphenylene sulfide films are expected to be useful in manufacturing circuit substrates because the films have high heat resistance and are only slightly varied in size when the films absorb water; however, there is a problem in that the films have a large thermal expansion coefficient. ~~In order to~~To solve the problem, the following techniques are disclosed: techniques for using glass fibers or particulate inorganic fillers (see ~~Patent Documents 1 and 2~~Japanese Unexamined Patent Application Publication No. 5-310957 and Japanese Patent No. 2952923). However, these techniques are problematic in that satisfactory improvements cannot be achieved, film flatness and/or smoothness is unsatisfactory, and manufacturing cost is high.

***Please replace the paragraph spanning pages 3 and 4 with the following:***

Films for print materials such as image-forming materials and printout materials for printers need to have good cushion properties. The following films are disclosed: porous films prepared by mixing polyester, a thermoplastic resin other than polyester, and inorganic particles and then stretching the mixture (see ~~Patent Documents 3, 4, and 5~~Japanese Examined Patent Application Publication No. 6-96281 and Japanese Unexamined Patent Application Publication Nos. 2-29438 and 6-322153). These films are problematic in that they have unsatisfactory dimensional stability and flexibility.

***On page 4, kindly replace the first full paragraph with the following:***

Since recent high-performance electronic devices need to process digital signals at high speed, films used for such applications need to have high performance. ~~In order to~~To reduce dielectric loss during transmission, thermoplastic resin films for insulating flexible printed circuits, cable insulation jackets, and motor transformer components need to have low dielectric constant and dielectric loss tangent, which are electrical characteristics necessary to cope with high frequencies due to high-speed signal processing. In particular, apparatuses including rotating units such as motors are inverter-controlled such that the apparatuses are precisely controlled to achieve high efficiency and high performance. This leads to an increase in the amount of high-frequency currents leaking from insulating materials.

***Kindly replace the paragraph spanning pages 4 and 5 with the following:***

~~In order to~~To obtain insulating films with low dielectric constant, a technique for forming independent pores is used because the dielectric constant of gas is low, one. Examples of such a technique include (a) a technique for forming pores using a blowing agent (see ~~Patent Document 6~~Japanese Patent No. 3115215), (b) a technique for forming micropores by blending polymers

incompatible with each other and then stretching the blend (see ~~Patent Documents 7 and 8~~Japanese Unexamined Patent Application Publication Nos. 9-286867 and 11-92577), and (c) a technique for forming micropores by subjecting a polymer blend containing two or more thermoplastic polymers to spinodal decomposition to make phase separation occur and removing at least one of the polymers by etching, thermolysis, or alkali decomposition (see ~~Patent Document 9~~Japanese Unexamined Patent Application Publication No. 2003-64214).

***Kindly replace the paragraph spanning pages 5 and 6 with the following:***

A thermoplastic polymer film prepared by technique (a) has portions having different dielectric constants due to the nonuniform distribution of the pores and has low formability and heat resistance due to the blowing agent used to form the pores. For a thermoplastic polymer film prepared by technique (b), the distribution of the micropores is nonuniform and the formability is low because the blending of the incompatible polymers cannot be sufficiently controlled. For a thermoplastic polymer film prepared by technique (c), a process for manufacturing this film is complicated and is not therefore suitable for practical use because at least one of the polymers must be removed so as to form the micropores.

Patent Document 1: Japanese Unexamined Patent Application Publication No. 5-310957

Patent Document 2: Japanese Patent No. 2952923

Patent Document 3: Japanese Examined Patent Application Publication No. 6-96281

Patent Document 4: Japanese Unexamined Patent Application Publication No. 2-29438

Patent Document 5: Japanese Unexamined Patent Application Publication No. 6-322153

Patent Document 6: Japanese Patent No. 3115215

Patent Document 7: Japanese Unexamined Patent Application Publication No. 9-286867

Patent Document 8: Japanese Unexamined Patent Application Publication No. 11-92577

Patent Document 9: Japanese Unexamined Patent Application Publication No. 2003-64214

*On page 6, kindly replace the first two full paragraphs with the following:*

It is ~~an object of the present invention~~could therefore be helpful to provide films having high thermal dimensional stability, good cushion properties, and low dielectric properties.

~~Patent Documents 10 and 11~~Japanese Unexamined Patent Application Publication Nos. 10-298313 and 11-5855 disclose films containing polyester and a liquid-crystalline polymer dispersed therein. However, network structures, cracks, and/or pores described below are not disclosed in these patent documents.

~~Patent Document 10: Japanese Unexamined Patent Application Publication No. 10-298313~~

~~Patent Document 11: Japanese Unexamined Patent Application Publication No. 11-5855~~

*Kindly replace the preamble of the paragraph at the bottom of page 6 with the following:*

~~Disclosure of Invention~~Summary

~~The present invention~~We provide[[s]] the following films, method, and materials:

*On page 9, kindly replace sub-paragraph (14) with the following:*

(14) The laminated film specified in any one of items (1) to (13), wherein the longitudinal thermal expansion coefficient and transverse thermal expansion coefficient thereof are 3 to 45 ppm/°C.

(The laminated film specified items (1) to (14) is referred to as a first laminated film ~~of the present invention.~~)

***On page 11, kindly replace sub-paragraph (27) with the following:***

(27) The laminated film specified in any one of items (15) to (26), wherein the longitudinal thermal expansion coefficient and transverse thermal expansion coefficient thereof are 3 to 45 ppm/°C.

(The laminated film specified items (15) to (27) is referred to as a second laminated film ~~of the present invention.~~)

***Kindly replace the paragraph spanning pages 11 and 12 with the following:***

~~According to the present invention, a~~ film having satisfactory thermal dimensional stability, cushion properties, and dielectric properties can be obtained.

***On page 12, kindly replace the first full paragraph with the following:***

#### Brief Description of the Drawings

FIG. 1 is a schematic view showing a typical network structure present in a layer included in a laminated film ~~of the present invention.~~

***On page 12, kindly replace the third full paragraph with the following:***

#### ~~Best Mode for Carrying Out the Invention~~Detailed Description

[[A]]The laminated film ~~of the present invention~~ includes at least two film layers and at least one of the layers contains a thermoplastic resin composition.

***Kindly replace the paragraph spanning pages 12 and 13 with the following:***

The thermoplastic resin composition contains a polymer that can be biaxially stretched. Examples of such a polymer include polyester, polyarylate, polyphenylene sulfide, polyimide, polyether imide, polyamide, polyamidoimide, modified polyphenylene oxide, polycarbonate,

polypropylene, polyethylene, polyether ketone, polyketone, polyethersulfone, polysulfone, polylactic acid, and copolymers of these polymers. A blend containing at least one of these polymers may be used. ~~In the present invention, in~~In view of biaxial stretchability and the advantages ~~of the present invention~~, the following polymers are preferable: polyester, polyphenylene sulfide, polyether imide, polycarbonate, polyether ketone, polyethersulfone, polysulfone, and polylactic acid. In particular, polyester and polyphenylene sulfide are preferable. Polyester is especially preferable.

***Kindly replace the paragraph spanning pages 14 and 15 with the following:***

The polyester may contain a constituent derived from a monofunctional compound such as lauryl alcohol or phenyl isocyanate. The polyester may contain a constituent derived from a trifunctional compound such as trimellitic acid, pyromellitic acid, glycerol, pentaerythritol, or 2,4-dioxybenzoic acid as long as the polymer are not excessively branched nor crosslinked but are substantially linear. Furthermore, the polyester may contain a small amount of a constituent derived from an aromatic hydroxycarboxylic acid such as p-hydroxybenzoic acid, m-hydroxybenzoic acid, or 2,6-hydroxynaphthoic acid; p-aminophenol; or p-aminobenzoic acid unless the advantages ~~of the present invention~~ are reduced.

***Kindly replace the paragraph spanning pages 16 and 17 with the following:***

~~In order to~~To achieve good thermal adhesiveness and hygroscopic dimensional stability in addition to the above advantages of the PPS, the resin composition preferably has a PPS content of 60 percent by weight or more. When the PPS content is 60 percent by weight or more, the resin composition has the same advantages as those of the PPS. The resin composition may further contain a polymer other than the PPS, an inorganic or organic filler, a lubricant, and/or a colorant unless the PPS content is less than the above value.



***On page 17, kindly replace the third full paragraph with the following:***

It is critical that the first laminated film ~~of the present invention~~ include at least another one of film layers that includes a network structure. The laminated film has a low dielectric constant and good cushion properties because this layer includes the network structure or a porous structure. Since the laminated film has low stiffness, the film has high morphological stability. Furthermore, since the thermal expansion of the film is low, the film has high thermal dimensional stability.

***On page 18, kindly replace the first paragraph with the following:***

The network structure has a configuration in which linear elements having a fibrillar shape, a rod shape, or a bead shape extend in film layer are connected to each other so as to form a network. Alternatively, the network structure has a configuration in which connected pores extend in parallel to a surface of the film in the longitudinal and/or transverse direction of the film to form a pseudo-network. In the network structure, the elements may be curved or partly disconnected from each other unless the advantages ~~of the present invention~~ are reduced.

***On page 19, kindly replace the second full paragraph with the following:***

~~In order to~~To achieve ~~[[the]]desired~~ advantages ~~of the present invention~~, the network structure preferably has porosity of 20% to 80%, more preferably 30% to 70%, and further more preferably 30% to 60% on an area basis.

***On page 19, kindly replace the fourth full paragraph with the following:***

The configuration involving the network structure or pores described above is common to the second laminated film ~~of the present invention~~.

***Kindly replace the paragraph spanning pages 19 and 20 with the following:***

In the second laminated film ~~of the present invention~~, it is critical that at least another one layer contain the non-ductile resin composition.

***On page 26, kindly replace the first full paragraph with the following:***

~~In order to~~To readily form the network structure or the pores, the liquid-crystalline polymer preferably has a fluid point of 200°C to 360°C. In view of the blending with a non-liquid-crystalline polyester described below, the liquid-crystalline polymer more preferably has a fluid point of 230°C to 320°C.

***On page 26, kindly replace the third full paragraph with the following:***

~~In a laminated film of the present invention, the~~The non-ductile resin composition preferably further contains an additional polymer other than the non-ductile polymer. Alternatively, the network structure-including film layer included in the first laminated film ~~of the present invention~~ preferably contains such an additional polymer. When the additional polymer is used, the network structure or the pores can be efficiently formed in the thermoplastic resin composition-containing layer by biaxially stretching the laminated film.

***Kindly replace the paragraph spanning pages 26 and 27 with the following:***

In view of the adhesion between these layers and the advantages ~~of the present invention~~, the additional polymer is preferably the same as a polymer contained in the thermoplastic resin composition contained in a layer that is in contact with the network structure-including film layer or the non-ductile resin composition-containing film layer. Since the thermoplastic resin composition preferably contains polyester as described above, the additional polymer is preferably a non-liquid-crystalline polyester. The non-liquid-crystalline polyester has a constituent derived

from an acid such as an aromatic dicarboxylic acid, an alicyclic dicarboxylic acid, or an aliphatic dicarboxylic acid and a constituent derived from a diol.

***Kindly replace the paragraph spanning pages 28 and 29 with the following:***

The number of layers arranged in ~~[[a]]the~~ laminated film ~~of the present invention~~ is preferably two to 1000. In view of the advantages, workability, and productivity of the laminated film, the film preferably has the following layer arrangement: B/A/B, C/B/A/B/C, C/B/A/B, or the like, wherein A represents the network structure-including film layer or the non-ductile resin composition-containing film layer and C and B represents the biaxially oriented layers containing the thermoplastic resin composition. That is, the biaxially oriented layers are preferably placed on both faces of the layer represented by A. In particular, the three-layer arrangement B/A/B, in which the biaxially oriented layers which contain the same resin composition and which has the same thickness are placed on both faces of the layer represented by A, is preferable, because the laminated film can be prevented from being distorted during the processing thereof and the flatness of the film can therefore be maintained.

***On page 29, kindly replace the first and second full paragraphs with the following:***

~~[[A]]The~~ laminated film ~~of the present invention~~ may contain a nucleating agent, a pyrolysis inhibitor, a heat stabilizer, an antioxidant, an ultraviolet absorber, an antistatic agent, a flame retardant, pigment, or dye unless the advantages of the ~~present invention~~film are reduced.

~~In order to~~To impart slipability, wear resistance, and/or scratch resistance to surfaces of the laminated film, the film may contain an organic lubricant such as fatty ester or wax, a surfactant, and/or inorganic or organic particles for forming surface irregularities. A catalyst may be added to the laminated film during polymerization, whereby internal particles may be allowed to remain therein.

***On page 31, kindly replace the first paragraph with the following:***

~~In usual, a~~The laminated film ~~of the present invention~~ preferably has a thickness of 500  $\mu\text{m}$  or less and more preferably 0.5 to 400  $\mu\text{m}$ . In view of thin-film applications and/or handling, the thickness of the film is preferably 10 to 300  $\mu\text{m}$  and more preferably 20 to 200  $\mu\text{m}$ . The film thickness is preferably 2.0 to 10  $\mu\text{m}$  for magnetic tape applications, 0.5 to 15  $\mu\text{m}$  for capacitor applications, 12 to 250  $\mu\text{m}$  for circuit or release liner applications, and 75 to 400  $\mu\text{m}$  for electrical insulation applications.

***On page 32, kindly replace the first and second paragraphs with the following:***

It is critical that the second laminated film ~~of the present invention~~ has a specific gravity of 0.2 to 1.2. Also, the first laminated film ~~of the present invention~~ preferably has such a specific gravity. The laminated films ~~of the present invention~~ more preferably have a specific gravity of 0.3 to 1.0 and further more preferably 0.4 to 0.7. When the laminated films have a specific gravity of 1.2 or less, the films have a sufficient number of pourspores and therefore have good cushion properties; ~~hence, the advantages of the present invention can be achieved.~~ When the laminated films have a specific gravity of 0.2 or more, the number of the pourspores in the films is not excessive; ~~hence.~~ Hence, the strength and dimensional stability of the films are well balanced.

~~In a laminated films of the present invention, the~~The longitudinal (MD) Young's modulus and transverse (TD) Young's modulus thereof are preferably 2 to 7 GPa. The lower limits of the moduli are preferably 2.5 GPa and more preferably 3 GPa. The upper limits of the moduli are preferably 6 GPa and more preferably 5 GPa. When the moduli are 7 GPa or less, the laminated film can be prevented from being distorted or curled, that is, the film has high dimensional stability. When the moduli are 2 GPa or more, the laminated film is firm and easy to handle.

***Kindly replace the paragraph spanning pages 32 and 33 with the following:***

~~In a laminated film of the present invention, the~~The longitudinal (MD) heat shrinkage and transverse (TD) heat shrinkage thereof are preferably 0% to 2% at 150°C, in view of heat resistance. The upper limits of the heat shrinkage are more preferably 2.0% or less, further more preferably 1.0% or less, still further more preferably less than 1.0%, and most preferably 0.5% or less. When upper limits of the heat shrinkage are 2.0% or less, the laminated film has high heat resistance and thermal dimensional stability. When the heat ~~shrinkage~~shrinkage are 1.0% or less, the laminated film has high flatness. The lower limits of the heat shrinkage are preferably 0.01% or more. When the lower limits thereof are 0.01% or more, the film can be prevented from being wrinkled due to the expansion of the film and the flatness of the film can be prevented from being deteriorated.

***Kindly replace the paragraph spanning pages 33 and 34 with the following:***

~~In a laminated film of the present invention, the~~The longitudinal (MD) thermal expansion coefficient and transverse (TD) thermal expansion coefficient thereof are preferably 3 to 45 ppm/°C. The lower limits of the coefficients are preferably 4 ppm/°C or more, more preferably 5 ppm/°C or more, and further more preferably 10 ppm/°C or more. The upper limits of the coefficients are preferably 35 ppm/°C or less, more preferably 30 ppm/°C or less, further more preferably 25 ppm/°C or less, and still further preferably 20 ppm/°C or less. When the thermal expansion coefficients are controlled within the above range, the film can be prevented from being distorted or curled due to heat in a step of processing the film for circuit applications or release liner applications.

***On page 34, kindly replace the first and second full paragraphs with the following:***

[[A]]The laminated film ~~of the present invention~~ preferably has a cushion factor of 10% to 50%, more preferably 15% to 45%, and further more preferably 20% to 40%. When the cushion factor thereof is 10% or more, the film is flexible; hence, a building material, such as wallpaper, including the film is easy to process. Furthermore, cost per area can be reduced. When the cushion factor is 50% or less, the strength and dimensional stability of the film can be well balanced and the film is superior in productivity.

[[A]]The laminated film ~~of the present invention~~ preferably has a dielectric constant of 1.3 to 3.0 at 10 kHz and 30°C, more preferably 1.5 to 2.7, and further more preferably 1.7 to 2.5. When the dielectric constant thereof is 3.0 or less, currents can be prevented from leaking from an electrical insulation material including the film; ~~hence,~~ Hence, electric losses and heat generation due to the losses can be minimized; ~~hence, and~~ and the advantages ~~of the present invention~~ can be achieved. ~~In order to~~ To balance the strength and productivity of the film by appropriately controlling the porosity of the film, it is sufficient that the dielectric constant be reduced to about 1.3.

***Kindly replace the paragraph spanning pages 34 and 35 with the following:***

[[A]]The laminated film ~~of the present invention~~ may further include a polymer layer made of, for example, polycarbonate, polyolefin, polyamide, polyvinylidene chloride, or an acrylic polymer. Such a polymer layer may be joined to another layer of the film directly or with an adhesive layer placed therebetween.

***On page 35, kindly replace the first through third full paragraphs with the following:***

[[A]]The laminated film ~~of the present invention~~ may be subjected to heat treatment, molding, surface treatment, lamination, coating, printing, embossing, or etching.

~~[[A]]~~The laminated film ~~of the present invention~~ is suitable for various industrial uses such as process materials, release materials, print materials, molding materials, building materials, magnetic recording materials, circuit materials, and electrical insulation materials.

~~In a laminated film of the present invention, the~~The network structure or the porous structure can be formed as described below. A method for producing a laminated film ~~according to the present invention~~ includes a step of coextruding at least two resin compositions, one of the compositions being thermoplastic, another one being non-ductile, and a step of forming pores in a layer containing the non-ductile resin composition by biaxial stretching.

***On page 37, kindly replace the second full paragraph with the following:***

A procedure for allowing polyethylene terephthalate to contain the particles is preferably as follows: the particles are dispersed in ethylene glycol and the resulting ethylene glycol is polymerized with terephthalic acid. ~~In order to~~To disperse the particles in the ethylene glycol, water sol or alcohol sol prepared to produce the particles is preferably added to the ethylene glycol without drying. Alternatively, the following procedure is preferable: slurry containing the particles is directly mixed with polyethylene terephthalate pellets and the mixture is kneaded with a vented twin-screw kneading extruder.

***On page 38, kindly replace the first paragraph with the following:***

~~In order to~~To control the particle content, master chips with high particle content is preferably prepared by any one of the above procedures in advance and then mixed with chips containing substantially no particles during film formation.

***Kindly replace the paragraph spanning pages 40 and 41 with the following:***

~~In the present invention, if~~If the liquid-crystalline polymer is blended with an additional polymer, the following technique may be used: a technique for melt-kneading the liquid-

crystalline polymer and the additional polymer in advance, pelletizing the mixture, and then melt-extruding the pellets into master chips; a technique for melt-kneading the liquid-crystalline polymer and the additional polymer to melt-extrude the mixture; or another technique. It is preferable to prepare such master chips because the polymers are uniformly mixed and a high-quality film having good formability can therefore be prepared using the master chips.

***On page 42, kindly replace the first and second full paragraphs with the following:***

Pellets of the liquid-crystalline polymer pellets of the PET are mixed at a ratio suitable for preparing the master chips. The mixture is fed to a vented twin-screw kneading extruder and then melt-kneaded at a temperature of 280°C to 320°C. ~~In order to~~To prevent mixing failure, the vented twin-screw kneading extruder preferably includes two double- or triple-thread screws. The residence time of the mixture in the extruder is preferably one to five minutes.

~~In order to~~To adjust the content of the liquid-crystalline polymer in the non-ductile resin composition to a desired value, the master chips prepared as described above are mixed with chips of the PET. This mixture is vacuum-dried at about 180°C for three hours or more and then fed to the extruder including a compression zone heated to a temperature of 270°C to 320°C. Since the master chips are mixed with the PET chips, the temperature of the compression zone is more preferably 290°C to 310°C.

***Kindly replace the paragraph spanning pages 42 and 43 with the following:***

~~In order to~~To prevent the laminated film from containing contaminants, foreign matter[[s]] and/or deteriorated polymer matter[[s]] are preferably removed from the extruders by filtration when the polymers are melt-extruded from the extruders. Filters used in this step are preferably made of sintered metal, porous ceramic, sand, or gauze.



***On page 43, kindly replace the first full paragraph with the following:***

~~In order to~~To constantly feed the polymers, the extruders preferably include gear pumps.

***On page 44, kindly replace the fifth full paragraph with the following:***

~~In order to~~To achieve the advantages of the present invention, the film is relaxed by 1% to 10% and more preferably 9% or less in the longitudinal and/or transverse direction during the heat treatment of the film or the cooling of the heat-treated film.

***On page 48, kindly replace the first and second full paragraphs with the following:***

The resulting film is preferably cooled at a temperature of 40°C to 180°C in such a manner that the film is transversely relaxed. ~~In order to~~To reduce the transverse heat shrinkage, the relaxation rate of the film is preferably 1% to 10%, more preferably 2% to 8%, and further more preferably 3% to 7%.

The resulting film is cooled to room temperature and then rolled, whereby a laminated film of the present invention is obtained.

***Kindly replace the paragraph spanning pages 78 and 79 with the following:***

The configuration and properties of the obtained laminated films are shown in Tables 5 and 6. These laminated films have a density outside the scope of the present invention this disclosure and are inferior in dielectric constant, cushion factor, flexibility, thermal expansion coefficient, and flatness.